

Full Length Research Paper

Effects of aqueous extract of *Basella alba* leaves on haematological and biochemical parameters in albino rats

Bamidele, O.^{1*}, Akinnuga, A. M.², Olorunfemi, J. O.³, Odetola, O. A.³, Oparaji, C. K.³ and Ezeigbo, N.³

¹Department of Physiology, Bowen University, Iwo, Osun State, Nigeria.

²Department of Nursing Science, Lead City University, Ibadan, Oyo State, Nigeria.

³Department of Physiology, Madonna University, Okija, Anambra State, Nigeria.

Accepted 2 September, 2010

The effects of the aqueous leaf extract of *Basella alba* on haematological and biochemical parameters were studied in Wistar strain albino rats. Twenty four (24) Wistar strain albino rats were randomly distributed into four groups of six (6) rats each. Group I rats served as control and received 10 ml/kg of normal saline, while group II, III and IV received 60, 80 and 100 mg/kg of aqueous leaf extract of *B. alba*, respectively, for two weeks. Administration of the extract was done orally. At the end of the treatment period, haematological parameters (red blood cell count, white blood cell count, platelet count, packed cell volume and haemoglobin concentration) and biochemical parameters (alkaline phosphatase (ALP), alanine aminotransaminase (ALT) and aspartate aminotransaminase (AST)) were determined. The results showed that *B. alba* significantly increased ($p < 0.05, 0.01$) red blood cell count, white blood cell count, packed cell volume, haemoglobin concentration and platelet count. However, the extract significantly ($p < 0.05, 0.01$) reduced the activity of the liver enzymes such as ALP, ALT and AST. The decreases were dose dependent. In conclusion, adding *B. alba* leaves as part of daily diet may reduce anaemia and maintain good health.

Key words: *Basella alba*, haematological parameters, biochemical parameters, albino rats.

INTRODUCTION

Basella alba (family Basellaceae) is a fast growing vegetable, native to tropical Asia, probably originating from India or Indonesia and extremely heat tolerant (Grubben and Denton, 2004). It is grown throughout the tropics as a perennial and in warmer temperate region as an annual crop. Its thick semi-succulent heart-shaped

leaves have a mild flavour and mucilaginous texture. It is commonly known as Malabar, Ceylon, East-Indian, Surinam and Chinese spinach (Facciola, 1990).

It is high in vitamin A, vitamin C, vitamin B9 (folic acid), calcium, magnesium and several vital anti-oxidants. It is low in calories by volume and high in protein per calorie (Duke and Ayensu, 1985). A work done in Bangladeshi showed that the daily consumption of Indian spinach has a positive effect on vitamin A stores in populations at high risk of vitamin A deficiency (Haskell et al., 2004). In addition, the cooked roots and leaves have been reported to be used in the treatment of diarrhoea and as laxative, respectively (Larkcom, 1991; Philips and Rix, 1995). The flowers are used as an antidote for poisons (Duke and Ayensu 1985). It is also a safe aperient for pregnant women and its decoction has been used to alleviate labour (Duke et al., 1985). Moreover, it is locally reported

*Corresponding author. E-mail: femi_bayo_is@yahoo.co.uk.
Tel: +2348067463528.

Abbreviations: ALP, Alkaline phosphatase; ALT, alanine aminotransaminase; AST, aspartate aminotransaminase; PCV, packed cell volume; RBC, red blood cell; count, WBC, white blood cell; Hb, haemoglobin; EDTA, ethylenediaminetetraacetic acid.

to be used in the treatment of anaemia. Its extract has demonstrated androgenic potential in adult rats and bull Leydig cells (Moundipa et al., 2005).

In spite of its many biological uses and the fact that several studies (Alada et al., 2004; Bolarinwa et al., 1991) have implicated the relative importance of some animal and vegetable protein diets in the formation and composition of blood, there is dearth of information encountered in the literature on the effect of *B. alba* on haematological parameters. Also, in view of the increasing use of *B. alba* in several communities by traditional healers to cure many diseases in patients without considering its adverse effects, it is necessary to scientifically investigate its effect on biochemical parameters. Therefore, the present study was undertaken to investigate the effect of aqueous extract of *B. alba* leaves on haematological and biochemical parameters in Wistar strain albino rats.

MATERIALS AND METHODS

Animal model

Wistar strain albino rats weighing between 140 – 180 g were used. The rats were purchased at the animal house of the College of Medical Sciences, University of Nigeria, Nsukka. The rats were housed in wire mesh cages under standard conditions (temperature, 25 - 29°C, 12 h light and 12 h dark cycle) and fed with standard rat pelleted diet and water was given *ad libitum*.

Plant materials

The fresh leaves of *B. alba* (Indian spinach) were procured from Otor market in Lagos, western Nigeria. The plant materials were identified and authenticated in the Department of Pharmacognosy, Faculty of Pharmacy, Madonna University, Elele Campus. The leaves were washed in tap water and shade-dried after which they were reduced into fine powder by grinding. 100 g of the powered leaves was stirred into 1000 ml of boiling distilled water. Boiling was allowed to continue for 5 min. The mixture was kept off the hot plate, for 30 min to allow it to infuse. It was then filtered using cheese cloth. The filtrate was then concentrated using a rotary vacuum evaporator to obtain the solid mass. The extract was then dissolved in normal saline and used for the study.

Experimental design

Twenty four (24) Wistar strain albino rats were randomly distributed into four groups of six (6) animals per group. Group I consists of rats which received 10 ml/kg normal saline and served as the control. Group II, III and IV received the aqueous extract of *B. alba* leaves at doses of 60, 80 and 100 mg/kg, respectively. Administration of the extract was done through gastric intubation once a day for a period of 14 days. Blood samples were collected from the animal through cardiac puncture into ethylenediaminetetraacetic acid (EDTA) bottles after anaesthetizing the animals with chloroform at the 14th day of the experiment. The blood samples were divided into two: First portion was used to determine haematological parameter, while the second portion was used to determine biochemical parameters. The second portion of blood was allowed to clot and then centrifuged at 150 g for 10 min. Serum obtained was used for the assay of alkaline phosphatase (ALP), alanine aminotransaminase (ALT) and aspartate aminotransaminase

(AST).

Blood analysis

The blood samples were analyzed to determine the haematological parameters such as: Packed cell volume (PCV), red blood cell (RBC) count, white blood cell (WBC) count, platelet count and haemoglobin concentration (Hb Conc.) using an automated haematology ANALYZER KX-21N, made by sysmex Japan. The sysmex KX-21 is an automatic multi-pair blood cell counter for *in vitro* diagnostic use in clinical laboratory. It performs speedy and accurate analysis of blood parameters and detects the abnormal samples. The automated haematology analyzer reading correlated well with readings by the standard manual methods (Samuel et al., 2010). Biochemical analysis of the serum enzymes for ALT and AST was by the method of Reitman and Frankel (1957). ALP was assayed according to the method of Rec (1972).

Statistical analysis

All data were presented as mean \pm SEM. The one way ANOVA was used to analyze the data, followed by a post-hoc test (LSD). The results were considered significant at p values of less than 0.05.

RESULTS

Haematological parameters

The results of the effects of the aqueous extract of *B. alba* on red blood cell count, white blood cell count, packed cell volume, haemoglobin concentration and platelet count are shown in Table 1. Oral administration of the aqueous extract of *B. alba* for two weeks caused gradual but significant increases in the mean RBC count in the treated groups of rats (5.87 ± 0.04 , 6.24 ± 0.34 and $8.60 \pm 0.28 \times 10^6$ cells/mm³ for groups II, III and IV, respectively). The increases were dose dependent. There were increases with no significant differences in the mean total WBC count in groups II ($6.89 \pm 0.65 \times 10^6$ cells/mm³) and III ($7.60 \pm 0.13 \times 10^6$ cells/mm³) when compared with the control ($6.70 \pm 0.50 \times 10^6$ cells/mm³), whereas there was significant increase ($p < 0.05$) in group IV ($8.93 \pm 0.26 \times 10^6$ cells/mm³). The mean PCV increased significantly ($p < 0.05$) in the treated rats as compared with the control group. The percentage increases were 7, 29 and 46, percent in group II, III and IV, respectively. The mean Hb concentration also increased significantly ($p < 0.05$) in a dose dependent fashion in the treated rats when compared with the control group. The percentage increases were 19, 22 and 50% in group II, III and IV, respectively. The mean platelet count in group II was not significantly different from the control group but group III and IV showed significant increase ($p < 0.05$).

Biochemical parameters

The activities of the three major marker enzymes ALP,

Table 1. Effect of aqueous extract of *B. Alba* leaves on some haematological parameters.

Blood parameter	Group I (Control)	Group II (60 mg/kg)	Group III (80 mg/kg)	Group IV (100 mg/kg)
RBC ($\times 10^6/\text{mm}^3$)	4.61 \pm 0.06	5.87 \pm 0.041	6.24 \pm 0.34*	8.60 \pm 0.28**
WBC ($\times 10^3/\text{mm}^3$)	6.70 \pm 0.50	6.89 \pm 0.65	7.60 \pm 0.13	8.93 \pm 0.26*
PCV (%)	34.90 \pm 0.25	37.32 \pm 0.51*	45.10 \pm 0.38**	50.93 \pm 0.79**
Hb(g/dl)	7.80 \pm 0.25	9.30 \pm 0.51*	9.51 \pm 0.14*	11.70 \pm 0.47**
PLC ($\times 10^3/\text{mm}^3$)	199.87 \pm 2.13	198.56 \pm 2.16	205.45 \pm 0.10**	204.20 \pm 0.09*

Values are expressed as mean \pm S.E.M. *P < 0.05, **P < 0.01 (n = 6).

Table 2. Effect of aqueous extract of *B. alba* leaves on some biochemical parameters.

Biochemical parameter (μl)	Group I (Control)	Group II (60 mg/kg)	Group III (80 mg/kg)	Group IV (100 mg/kg)
ALAT	57.50 \pm 0.44	49.80 \pm 0.32**	52.10 \pm 0.19**	39.70 \pm 0.12**
ASAT	60.65 \pm 0.85	62.79 \pm 0.52	57.56 \pm 0.36*	41.08 \pm 0.69**
ALP	400.30 \pm 0.63	345.10 \pm 0.45**	322.40 \pm 0.72**	308.58 \pm 0.58**

Values are expressed as mean \pm S.E.M. *P < 0.05, **P < 0.01 (n = 6).

ALAT = Alanine aminotransaminase; ASAT = aspartate aminotransaminase; ALP = alkaline phosphatase.

ALT and AST were markedly affected after pre-treatment of the rats with aqueous extract of *B. alba* at different doses of 60, 80 and 100 mg/kg body weight. ALT activity significantly decreased ($p < 0.01$) in the rats pre-treated with various doses of the extract as shown in Table 2. There was a gradual decrease in the activity (62.79 ± 0.52 , 57.56 ± 0.36 and $41.08 \pm 0.69 \mu\text{l}$) of ALT in all the rats pre-treated with different doses of the extract. Groups that received 80 and 100 mg/kg body weight showed significant decrease ($p < 0.05$) when compared with the control value. The activity of ALP decreased significantly ($p < 0.01$) at different doses of the extract in the pre-treated rats (345.10 ± 0.45 , 322.40 ± 0.72 and $308.58 \pm 0.58 \mu\text{l}$) as compared with the control value ($400.30 \pm 0.63 \mu\text{l}$). The decrease in the activity of ALP in the pre-treated rats was dose dependent.

DISCUSSION

The results of the study shows that, the leaf extract of *B. alba* administered at the dosages used and for the period of the experiment has positive effect on the haemopoietic system. There was increase in the haematological parameters (RBC, WBC, PCV, Hb Conc. and platelet) in the treated rats when compared with the control group.

The significant increase in the haematological indices observed following treatment with *B. alba* aqueous leaf extract might not be unrelated to its chemical composition. The chemical composition of the leaf extract include: Proteins, fat, vitamin A, vitamin C, vitamin E, vitamin K, vitamin B9 (folic acid), riboflavin, niacin, thiamine and minerals such as calcium, magnesium and iron (Duke

and Ayensu, 1985; Grubben and Denton, 2004). Most of these vitamins and minerals are well-known hematinics and are necessary for the formation of blood cells (Ganong, 2005; Alada et al., 2004; Mitchell et al., 1976). The observed increases in the haemoglobin concentrations and packed cell volume in the rats treated with the aqueous leaf extract of *B. alba* in this study is consistent with earlier reports that protein-rich diets increase both packed cell volume and haemoglobin concentrations in human and animal studies (Alada et al., 2004; Alada, 2000; Bolarinwa et al., 1991, Mitchell, 1966).

The aqueous leaf extract of *B. alba* significantly reduced the activity of the liver enzymes (ALT, AST and ALP) in the treated rats when compared with the control group. The effect was dose dependent. Liver enzymes (ALT and AST) are released into the blood whenever liver cells are damaged and enzyme activity in the plasma is increased (Edwards et al., 1995). The fact that the enzyme activities were reduced showed that the extract improves hepatic functions.

Moreover, *B. alba* leaves are reported to contain antioxidant properties (Duke and Ayensu, 1985). Antioxidants are effective scavengers of super oxide anions. They are associated with several health benefits including their ability to protect against oxidative damage (Olmendilla et al., 1997). Therefore, the extract may have exhibited hepatoprotective activity due to its antioxidant properties which is attributable to flavonoids and carotinoids.

In conclusion, the results of this study confirmed the use of the *B. alba* leaves in traditional medicine for the treatment of anaemia. Thus, the leaves of the plant might have a promising role in the treatment and/or prevention of anaemia. On the other hand, the use of the leaves of

the plant at the dosages in this study may not have deleterious effect on the body system owing to its hepatoprotective potentials due to the presence of antioxidants.

REFERENCES

- Alada ARA (2000). The haematological effect of *Telfairia occidentalis* diet preparation in the rat. *Afr. J. Biomed. Res.* 3: 185-186.
- Alada ARA, Akande OO, Ajayi FF (2004). Effect of soya bean diet preparations on some haematological and biochemical indices in the rat. *Afr. J. Biomed. Res.* 7(2): 71-74.
- Bolarinwa AF, Oyebola DDO, Akindeinde GB (1991). Effect of malnutrition on basal and induced gastric acid secretion. *Niger. J. Physiol. Sci.* 5(2): 144-148.
- Duke JA, Ayensu ES (1985). *Medicinal Plants of China* Reference Publications, Inc. ISBN 0-917256-20-4.
- Edwards CRW, Bouchier IAD, Haslet C, Chilvers ER (1995). *Davidson's Principles and Practice of Medicine*, 17th edn. Churchill Livingstone, pp. 488-490.
- Facciola S (1990). *Cornucopia-A source Book of Edible Plants*. Kampong Publications. ISBN 0-9628087-0-9. 2: 183-187.
- Ganong WF (2005). *A review of medical physiology*. Appleton and Lange; p. 496.
- Grubben GJH, Denton OA (2004). *Plant Resources of Tropical Africa 2. Vegetable*. PROTA Foundation, Wageningen; Backhuys, Leiden; CTA, Wageningen. 4: 103-111.
- Haskell MJ, Jamil KM, Hassan F, Peerson JM, Hassain MI, Fuchs GJ, Brown KH (2004). Daily consumption of Indian spinach (*B. alba*) or sweet potatoes has positive effect on total-body vitamin A store in Bangladeshi men. *Am. J. Clin. Nutr.* 80(3): 705-714.
- Larkcom J (1991). *Oriental Vegetables* John Murray. ISBN 0-7195-4781-4784.
- Mitchell HS (1966). Protein limitation and human growth. *J. Am. Diet. A.* 44: 165-171.
- Mitchell HS, Rynbergen HJ, Anderson L, Dibble MV (1976). *Nutrition in health and disease*. 16 Ed. Lippincott JB. Company, Philadelphia.
- Moundipa PF, Beboy NSE, Zelefeck F, Ngouela S, Tsamo E, Schill W, Monsees TK (2005). Effect of *Basella alba* and *Hibiscus macranthus* extracts on testosterone production of adult rat and bull Leydig cells. *Asian J. Androl.* 7(4): 411-417.
- Olmendilla B, Granado F, Gil-Martinez E, Blanco I, Rojas-Hildago E (1997). Reference values from retinol, tocopherol and main carotenoids in serum of control and insulin dependent diabetic Spanish subjects. *Clin. Chem.* 43: 1066-1071.
- Philips R, Rix M (1995). *Vegetables* Macmillan Reference Books, London. ISBN 0-33362640-0.
- Rec Gsc (DGKC) (1972). Optimised standard colorimetric methods. *J. Clin. Chem. Clin. Biochem.* 10: p. 182.
- Reitman S, Frankel AS (1957). A colorimetric method of determination of serum glutamic oxaloacetic and glutamic pyruvic transaminases. *Am. J. Clin. Pathol.* 28: 53-63.
- Samuel OI, Thomas N, Ernest OU, Imelda N, Elvis NS, Ifeyinwa E (2010). Comparison of haematological parameters determined by the Sysmex KX-21N automated haematology analyzer and the manual counts. *BMC Clin. Pathol.* 10: p. 3.